

CLAIMS

1. A receiver for use in a wireless network, comprising:

 a first antenna, which is adapted to be directed toward a first transmitter positioned in a first location and transmitting a first signal carrying a first stream of digital information;

 a second antenna, which is adapted to be directed toward a second transmitter positioned in a second location, separated from the first location, and transmitting a second signal carrying a second stream of digital information; and

 processing circuitry, which is coupled to receive first and second receiver inputs from the first and second antennas, respectively, due to reception of the first and second signals by the antennas, and which is adapted to combine the first and second receiver inputs so as to extract at least the first stream of digital information from the receiver inputs while suppressing at least a first interference due to reception of the second signal by the first antenna.

2. The receiver according to claim 1, wherein the first and second signals are transmitted in a common frequency channel.

3. The receiver according to claim 1, wherein the processing circuitry is further adapted to extract the second stream of digital information from the receiver inputs while suppressing a second interference due to the reception of the first signal by the second antenna.

4. The receiver according to claim 1, wherein the processing circuitry is adapted to estimate an error in

the extracted stream of digital information, to determine coefficients in response to the estimated error, and to apply the coefficients to the first and second receiver inputs in order to suppress the interference.

5. The receiver according to claim 4, wherein the processing circuit is adapted to determine the coefficients so as to minimize a mean square of the error.

6. The receiver according to claim 4, wherein the processing circuitry is adapted to adjust the coefficients adaptively, in response to a change in a channel transfer function between at least one of the first and second transmitters and at least one of the first and second antennas.

7. The receiver according to claim 4, wherein the first and second signals comprise multi-carrier signals, and wherein the processing circuitry is adapted to divide the first and second receiver inputs into multiple frequency components, and to determine the coefficients to be applied individually to each of the frequency components.

8. The receiver according to claim 4, wherein the first and second signals comprises single-carrier signals, and wherein the processing circuitry comprises a tap-delay channel equalizer.

9. The receiver according to claim 1, wherein the receiver comprises a plurality of N antennas, including the first and second antennas, and wherein the processing circuitry is adapted to combine the receiver inputs from the N antennas so as to extract the first stream of

digital information while suppressing up to N-1 interferers, including the first interference.

10. The receiver according to claim 9, wherein the N-1 interferers comprise at least one interference source that is not a transmitter in the wireless network.

11. A transmitter for use in a wireless network, comprising:

a first antenna, which is adapted to be directed toward a first receiver positioned in a first location;

a second antenna, which is adapted to be directed toward a second receiver positioned in a second location, separated from the first location; and

signal generation circuitry, which is coupled to receive first and second streams of digital information to be conveyed to the first and second receivers, respectively, and which is adapted to combine the first and second streams of digital information so as to generate first and second signals for transmission respectively by the first and second antennas, such that at least a first interference due to the transmission of the second signal is suppressed at the first receiver.

12. The transmitter according to claim 11, wherein the signal generation circuit is adapted to generate the first and second signals for transmission in a common frequency channel.

13. The transmitter according to claim 11, wherein the signal generation circuitry is adapted to generate the first and second signals so that a second interference associated with the transmission of the first signal is suppressed at the second receiver.

14. The transmitter according to claim 11, wherein the signal generation circuitry is adapted to determine a channel transfer function between the first and second antennas and at least one of the first and second receivers, to determine coefficients based on the channel transfer function, and to apply the coefficients to the first and second streams of digital information in order to generate the first and second signals so as to suppress the interference.

15. The transmitter according to claim 14, wherein the signal generation circuitry is adapted to generate training signals for transmission to the first and second receivers, for use in determining the channel transfer function.

16. The transmitter according to claim 15, and comprising a return channel receiver, for receiving data associated with the coefficients from the first and second receivers in response to reception of the training signals at the first and second receivers.

17. The transmitter according to claim 14, wherein the first and second signals comprise multi-carrier signals, and wherein the signal generation circuitry is adapted to generate multiple frequency components of the signals, and to determine the coefficients to be applied individually to each of the frequency components.

18. The transmitter according to claim 14, wherein the first and second signals comprise single-carrier signals, and wherein the signal generation circuitry comprises a tap-delay channel pre-equalizer.

19. The transmitter according to claim 11, wherein the transmitter comprises a plurality of M antennas, including the first and second antennas, and wherein the signal generation circuitry is adapted to combine up to M streams of digital information so as to generate up to M signals for transmission respectively by the M antennas, such that up to $M-1$ interferers due to the transmission of the up to M signals, including the first interference, are suppressed at the first receiver.

20. Communication apparatus for use in a wireless network, comprising:

a first directional antenna, which is adapted to be directed toward a first remote antenna of a first node in a first location in the network;

a second directional antenna, which is adapted to be directed toward a second remote antenna of a second node in a second location in the network, separated from the first location;

signal generation circuitry, which is coupled to receive first and second streams of digital information to be conveyed to the first and second nodes, respectively, and which is adapted to combine the first and second streams of digital information so as to generate first and second outgoing signals for transmission respectively by the first and second directional antennas, such that at least a first interference due to the transmission of the second outgoing signal is suppressed at the first remote antenna; and

processing circuitry, which is coupled to receive first and second receiver inputs from the first and

second directional antennas, respectively, due to reception of first and second incoming signals by the antennas from the first and second nodes, respectively, and which is adapted to combine the first and second receiver inputs so as to extract a data stream from the receiver inputs while suppressing at least a second interference due to reception of the second incoming signal by the first directional antenna.

21. A wireless communication network, comprising a plurality of nodes, which comprise at least first and second nodes,

wherein each of the first and second nodes comprises a respective first antenna, such that the first antenna of the first node is directed to transmit a first signal toward the second node, and the first antenna of the second node is directed toward the first node so as to receive the first signal, and wherein at least the first node comprises a respective second antenna, which is directed toward another of the nodes in the network, and

wherein the first node comprises signal generation circuitry, which is coupled to receive a first stream of digital information to be conveyed to the second node and a second stream of digital information to be conveyed to another of the nodes, and

wherein the signal generation circuitry is adapted to combine the first and second streams of digital information so as to generate the first signal and to generate a second signal for transmission by the second antenna of the first node, such that at least a first interference due to the transmission of the second signal is suppressed at the second node.

22. The network according to claim 21, wherein the second node comprises a respective second antenna and processing circuitry, which is coupled to receive first and second receiver inputs from the first and second antennas of the second node, respectively, due to reception by the antennas of the second node of the first signal and of at least a third signal transmitted from another of the nodes in the network, and

wherein the processing circuitry is adapted to combine the first and second receiver inputs so as to extract at least the first stream of digital information from the receiver inputs while suppressing at least a second interference due to reception of the third signal by the first antenna of the second node.

23. The network according to claim 22, wherein the first and second nodes are adapted to suppress at least the first and second interferences substantially without dependence on synchronization between the nodes in the network.

24. The network according to claim 21, wherein at least a first subset of the nodes are arranged in a ring topology.

25. The network according to claim 24, wherein at least one of the nodes in the first subset is connected by a wireless link to another one of the nodes in a second subset of the nodes, which are not a part of the ring topology of the first subset.

26. The network according to claim 21, wherein the nodes are arranged in a mesh topology.

27. The network according to claim 21, wherein the nodes are arranged in a star topology, and wherein the first node is located at a hub of the star topology.

28. The network according to claim 27, wherein the signal generation circuitry is adapted to generate the first and second signals in accordance with a multiplexing scheme, so that multiple nodes in the network, including the second node, are served by the first antenna of the first node.

29. The network according to claim 28, wherein the multiplexing scheme is selected from a group of schemes consisting of TDMA and CDMA.

30. The network according to claim 21, wherein the first node is configured to transmit the first and second signals in a common frequency channel.

31. A wireless communication network, comprising a plurality of nodes, which comprise at least first and second nodes,

wherein each of the first and second nodes comprises a respective first antenna, such that the first antenna of the first node is directed to transmit a first signal carrying a first stream of digital information toward the second node, and the first antenna of the second node is directed toward the first node so as to receive the first signal, and wherein at least the second node comprises a second antenna, which is directed toward another of the nodes in the network, and

wherein the second node comprises processing circuitry, which is coupled to receive first and second receiver inputs from the first and second antennas of the second node, respectively, due to reception by the

antennas of the second node of the first signal and of at least a second signal transmitted from another of the nodes in the network, and

wherein the processing circuitry is adapted to combine the first and second receiver inputs so as to extract at least the first stream of digital information from the receiver inputs while suppressing at least a first interference due to reception of the second signal by the first antenna of the second node.

32. The network according to claim 31, wherein the second node is adapted to suppress at least the first interference substantially without dependence on synchronization between the nodes in the network.

33. The network according to claim 31, wherein at least a first subset of the nodes are arranged in a ring topology.

34. The network according to claim 33, wherein at least one of the nodes in the first subset is connected by a wireless link to another one of the nodes in a second subset of the nodes, which are not a part of the ring topology of the first subset.

35. The network according to claim 31, wherein the nodes are arranged in a mesh topology.

36. The network according to claim 31, wherein the nodes are arranged in a star topology, and wherein the second node is located at a hub of the star topology.

37. The network according to claim 36, wherein the processing circuitry is adapted to receive the first and second receiver inputs in accordance with a multiplexing scheme, so that multiple nodes in the network, including

the first node, are served by the first antenna of the second node.

38. The network according to claim 37, wherein the multiplexing scheme is selected from a group of schemes consisting of TDMA, CDMA and ALOHA..

39. The network according to claim 31, wherein the second node is configured to receive the first and second signals in a common frequency channel.

40. In a wireless network, in which a receiving node has a first antenna directed toward a first transmitter positioned in a first location and transmitting a first signal carrying a first stream of digital information, and a second antenna directed toward a second transmitter positioned in a second location, separated from the first location, and transmitting a second signal carrying a second stream of digital information, a method for processing the first and second signals at the receiving node, comprising:

receiving first and second receiver inputs from the first and second antennas, respectively, due to reception of the first and second signals by the antennas; and

combining the first and second receiver inputs so as to extract at least the first stream of digital information from the receiver inputs while suppressing at least a first interference due to reception of the second signal by the first antenna.

41. The method according to claim 40, wherein the first and second signals are transmitted in a common frequency channel.

42. The method according to claim 40, wherein combining the receiver inputs further comprises extracting the second stream of digital information from the receiver inputs while suppressing a second interference due to the reception of the first signal by the second antenna.

43. The method according to claim 40, wherein combining the receiver inputs comprises:

estimating an error in the extracted data stream;
determining coefficients in response to the estimated error; and

applying the coefficients to the first and second receiver inputs in order to suppress the interference.

44. The method according to claim 43, wherein determining the coefficients comprises computing the coefficients so as to minimize a mean square of the error.

45. The method according to claim 43, wherein determining the coefficients comprises adjusting the coefficients adaptively, in response to a change in a channel transfer function between at least one of the first and second transmitters and at least one of the first and second antennas.

46. The method according to claim 43, wherein the first and second signals comprise multi-carrier signals, and wherein determining the coefficients comprises dividing the first and second receiver inputs into multiple frequency components, and determining the coefficients respectively for at least some the frequency components, and wherein applying the coefficients comprises applying the coefficients individually to each of the frequency components.

47. The method according to claim 43, wherein the first and second signals comprises single-carrier signals, and wherein applying the coefficients comprises applying a tap-delay channel equalizer to suppress the interference.

48. The method according to claim 40, wherein the receiving node comprises a plurality of N antennas, including the first and second antennas, and wherein combining the first and second receiver inputs comprises combining the first and second receiver inputs with further inputs from the N antennas so as to extract the first stream of digital information while suppressing up to N-1 interferers, including the first interference.

49. The method according to claim 48, wherein the N-1 interferers comprise at least one interference source that is not a transmitter in the wireless network.

50. The method according to claim 40, wherein receiving the first and second receiver inputs comprises receiving the inputs in accordance with a multiplexing scheme, so that multiple transmitters in the network, including the first and second transmitters, are served by each of the first and second antennas of the receiving node.

51. The method according to claim 40, wherein combining the first and second receiver inputs comprises suppressing at least the first interference substantially without dependence on synchronization between the transmitters and the receiving node.

52. In a wireless network, in which a transmitting node has a first antenna directed toward a first receiver positioned in a first location, and a second antenna directed toward a second receiver positioned in a second

location, separated from the first location, a method for generating signals for transmission by the transmitting node, comprising:

receiving first and second streams of digital information to be conveyed to the first and second receivers, respectively; and

combining the first and second streams of digital information so as to generate first and second signals for transmission respectively by the first and second antennas, such that at least a first interference due to the transmission of the second signal is suppressed at the first receiver.

53. The method according to claim 52, wherein combining the first and second streams of digital information comprises generating the first and second signals for transmission in a common frequency channel.

54. The method according to claim 52, wherein combining the first and second streams of digital information comprises generating the first and second signals so that a second interference associated with the transmission of the first signal is suppressed at the second receiver.

55. The method according to claim 52, wherein combining the first and second streams of digital information comprises:

determining a channel transfer function between the first and second antennas and at least one of the first and second receivers;

computing coefficients based on the channel transfer function; and

applying the coefficients to the first and second streams of digital information in order to generate the

first and second signals so as to suppress the interference.

56. The method according to claim 55, wherein determining the channel transfer function comprises generating training signals for transmission to the first and second receivers, and determining the channel transfer function based on reception of the training signals at the receivers.

57. The method according to claim 56, wherein computing the coefficients comprises transmitting data associated with the coefficients from the at least one of the first and second receivers to the transmitting node in response to the reception of the training signals.

58. The method according to claim 55, wherein combining the data streams comprises generating multi-carrier signals having multiple frequency components, and wherein computing the coefficients comprises finding the coefficients to be applied individually to each of the frequency components.

59. The method according to claim 55, wherein the first and second signals comprises single-carrier signals, and wherein applying the coefficients comprises applying a tap-delay channel pre-equalizer to suppress the interference.

60. The method according to claim 52, wherein the transmitting node comprises a plurality of M antennas, including the first and second antennas, and wherein combining the first and second streams of digital information comprises combining the first and second streams with further streams of digital information so as

to generate up to M signals for transmission respectively by the M antennas, such that up to M-1 interferers due to the transmission of the up to M signals, including the first interference, are suppressed at the first receiver.

61. The method according to claim 52, wherein combining the first and second streams of digital information comprises generating the first and second signals in accordance with a multiplexing scheme, so that multiple receivers in the network, including the first and second receivers, are served by each of the first and second antennas of the transmitting node.

62. The method according to claim 52, wherein combining the first and second streams of digital information comprises suppressing at least the first interference substantially without dependence on synchronization between the transmitting node and the receivers.